

The concentration of organic compounds in high-pH waters of serpentinizing environments determined by ¹H NMR: continental sites (Oman, Liguria, New Caledonia, Portugal) and a marine environment (Marianna mud volcanoes: IODP Exp 366, ODP Legs 125 and 195)

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The very alkaline waters produced by low temperature serpentinization of ultramafic rocks may contain elevated concentrations of dissolved organic carbon likely to act as a substrate for microbial life. High-pH (up to 11.7) waters collected at on-land sites (Oman, Liguria, New Caledonia, Portugal) and porewaters (pH up to 12.5) collected in boreholes drilled during IODP Exp 366 in three Marianna forearc mud volcanoes (Yinazao, Fantangisña and Asùt Tesoru) have been analyzed for organic compounds using ¹H NMR spectroscopy. Whereas the waters collected at continental sites are devoid of organics, very high concentrations of acetate (up to 80 μmol/L), formate (up to 250 μmol/L), ethanol (up to 700 μmol/L), methanol (up to 300 μmol/L) and acetonitrile (up to 40 μmol/L) are found in porewaters collected in boreholes located at the summits of Yinazao and Asùt Tesoru, and on the flank of Fantangisña. On the contrary, porewater samples collected in other boreholes where the pH is around 8 do not contain these organic molecules, but do show noticeable amounts of acetate (up to 120 μmol/L) and formate (up to 50 μmol/L). When reported versus pH, the (inorganic and organic) porewater composition data including those for Conical (ODP Leg 125) and South Chamorro (ODP Leg 195) seamounts show evidence of a pH threshold around 11.5 above which all molecules or compounds usually involved in organic matter degradation (acetate, formate, ethanol, methanol, acetonitrile, dissolved

ammonium) show similar variations in concentration at almost constant pH. The discrepancy between DOC contents directly measured with the carbon elemental analyzer and those obtained from the sum of organics may be attributed to the loss of volatile organics during the CO₂ purge following sample acidification in standard DOC measurements.

It may be speculated that the origin of these organic molecules is the degradation of organic matter of sedimentary origin at high pH and not necessarily their abiotic formation from an inorganic carbon source (such as the reduction of CO₂).